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I, ANNA MAIJA MADL, ACTING TEAM LEADER EXAMINATION SUPPORT & SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. PP 7166 for a patent by THE UNIVERSITY OF SYDNEY filed on 12 November 1998.

COMMONWEALTH OF AUSTRALIA
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WITNESS my hand this
Twenty-fifth day of January 2000

A. M. Madl.

ANNA MAIJA MADL
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AUSTRALIA

Patents Act 1990

PROVISIONAL SPECIFICATION

Applicant(s):

THE UNIVERSITY OF SYDNEY

Invention Title:

BIREFRINGENCE COMPENSATION IN PLANAR WAVEGUIDES USING NEGATIVE INDEX CHANGES

The invention is described in the following statement:

The waveguide preferably can include an associated form birefringence which can be of an opposite sign to the stress birefringence of the substrates and of a greater magnitude then the stress birefringence so the process can result in a nullification of the two birefringences.

Brief Description of the Drawings

Notwithstanding any other forms which may fall within the scope of the present invention, preferred forms of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Fig. 1 illustrates an idealized wafer and waveguide;

Fig. 2 illustrates the process of reducing thermal stress in a waveguide;

Fig. 3 illustrates the step of thermal processing of substrate; and

Fig. 4 is a graph of the interaction of the various forms of birefringence on a substrate.

Description of Preferred and Other Embodiments

In the preferred embodiment, the form birefringence β_{form} is made slightly greater than the stress birefringence β_{stress} and of an opposite sign. Such layers, including a negative index grating within a germanosilicate planar waveguide, can be produced by utilizing a hollow cathode plasma enhanced chemical vapour deposition (HCPECVD) process such as that outlined in M V Bazylenko, M Gross, A Simonian, P L Chu, Journal of Vacuum Science and Technology, A14, (2) pp336-345, 1996 and J Canning, D Moss, M Aslund, M Bazylenko, Election Letters, 34(4) pp366-367 (1998).

Next, as illustrated in Fig. 3, the substrate 2 is thermally locally processed preferably by a UV laser or other thermal laser device such as a CO_2 laser to compensate for the form birefringence by increasing the stress birefringence in magnitude such that it cancels out the form birefringence. In this way, the stress within the

We Claim:

1. A method of modifying the birefringence properties of a waveguide wherein said waveguide is formed within a second substrate which is deposited on a first substrate, said second substrate having differing thermal expansion coefficients then said first substrate, said method comprising the step of:

applying localized thermal energy to a region of said first or second substrate closely adjacent said waveguide to modify the birefringence properties of said waveguide.

2. A method as claimed in claim 1 wherein the application of said localized thermal energy alters the stress bi-refringence in the vicinity of said waveguide.

3. A method as claimed in any previous claim wherein said applying step comprises utilizing a CO or CO2 laser.

4. A method as claimed in any previous claim wherein said waveguide includes an associated form bi-refringence which is of an opposite sign to the stress bi-refringence of said substrates.

5. A method as claimed in claim 4 wherein said form bi-refringence is greater then said stress bi-refringence.

6. A method as claimed in claim 5 wherein said form bi-refringence is negative.

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AUSTRALIA
PATENT OFFICE

WITNESS my hand this
Seventeenth day of December 1999

A.M. Madl

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ACTING TEAM LEADER
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AUSTRALIA

Patents Act 1990

PROVISIONAL SPECIFICATION

Applicant(s):

THE UNIVERSITY OF SYDNEY

Invention Title:

LASER TUNING AND POLARIZATION CONTROL OF PLANAR DEVICES

The invention is described in the following statement:

Brief Description of the Drawings

Notwithstanding any other forms which may fall within the scope of the present invention, preferred forms of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Fig. 1 illustrates schematically the process of thermal process of waveguides;

Fig. 2 illustrates an example application in a MNI type device; and

Fig. 3 illustrates an alternative form of processing of a waveguide type device.

Description of Preferred and Other Embodiments

In the preferred embodiment, local thermal processing of the wafer is carried out utilizing an infra-red or UV laser device. Suitable thermally sensitive waveguides, including a negative index grating within a germanosilicate planar waveguide, can be produced by utilizing a hollow cathode plasma enhanced chemical vapour deposition (HCPECVD)process such as that outlined in M V Bazylenko, M Gross, A Simonian, P L Chu, Journal of Vacuum Science and Technology, A14, (2) pp336-345, 1996 and J Canning, D Moss, M Aslund, M Bazylenko, Election Letters, 34(4) pp366-367 (1998). The application of the laser is preferably in the region of the waveguide so as to alter its optical properties. Preferably, the thermal processing utilized is designed to have minimal effect on the waveguide 1. Hence, if a UV laser is to be utilized then ideally it is utilized on the silicon substrate 2 which is opaque to UV rays. The localised heating can be utilized to cause localised changes in the device. The changes can include thermal relaxation of internal stresses, thermal diffusion of material or thermal damage of material layers. For example, Fig. 2 illustrates an add-drop multiplexer 10 constructed utilizing a Mach-Zehnder principle which can be initially constructed on a wafer and subsequently tuned by means of thermal rather than UV tuning of the arms at the points eg. 11, 12.

internal waveguides. Further, the devices can be tuned either at the waveguide or at the substrate. Preferably, an IR source is used so as to thermally heat and not damage the substrate.

It would be appreciated by a person skilled in the art that numerous variations and/or modifications may be made to the present invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects to be illustrative and not restrictive.

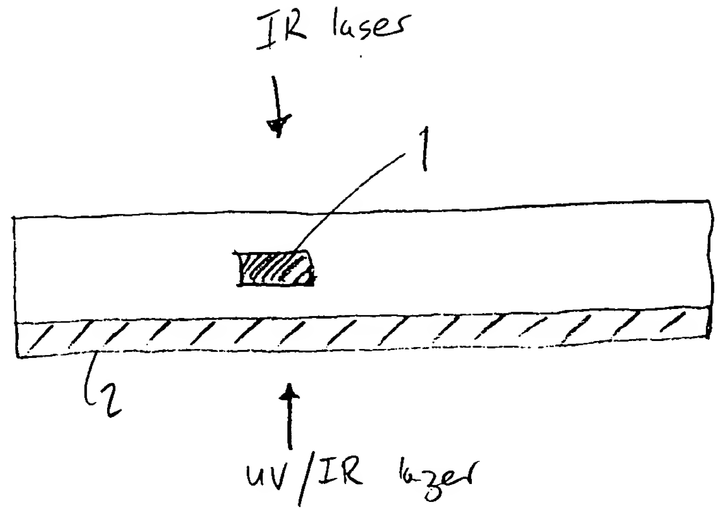

Fig. 1

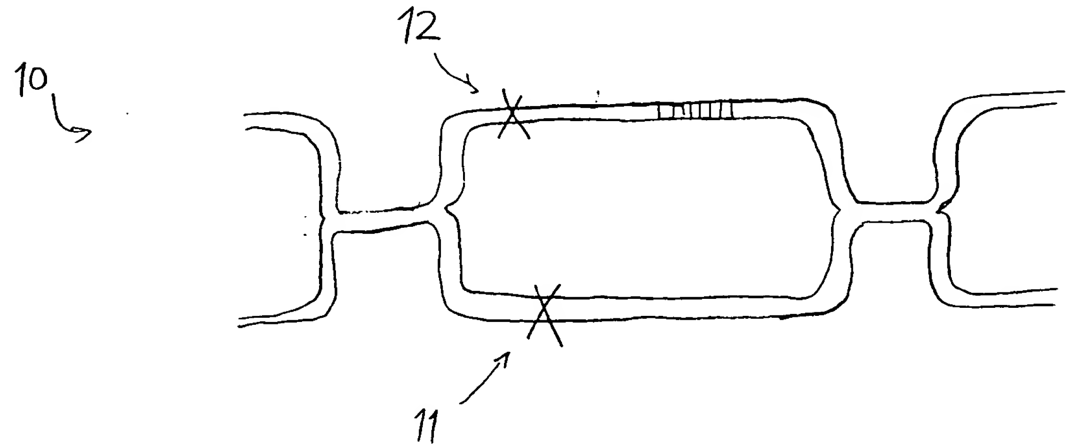

Fig. 2

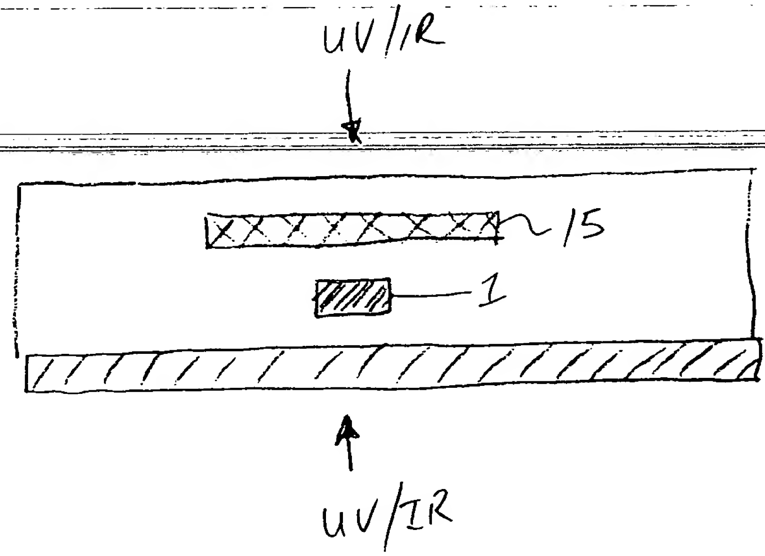

Fig. 3

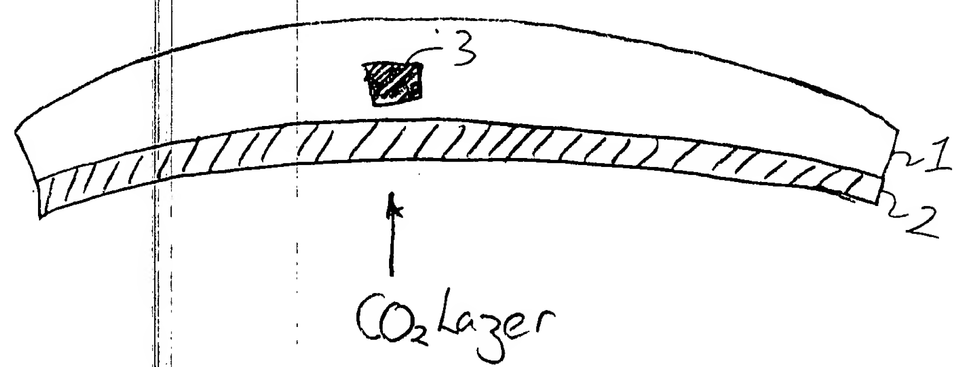

Fig. 3

Abstract

A method of modifying the birefringence properties of a waveguide wherein the waveguide is formed within a second substrate which is deposited on a first substrate, the second substrate having differing thermal expansion coefficients then the first substrate, the method comprising the step of: applying localized thermal energy to a region of the first substrate closely adjacent the waveguide to modify the birefringence properties of the waveguide.

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